Safety Review of the Existing Roads

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A road safety audit is a formal safety examination of a proposed change to an existing road, or a new highway scheme which is carried out throughout the design and construction period. In the audit, an independent, qualified team reports on the project's accident potential and makes recommendations for improvement. When the audit process is applied to an existing road it is called a 'road safety review'.

Road safety audits were first developed in the United Kingdom in the early 1980's for checking the safety performance of new road designs and improvement schemes, and some of the principles have now been extended to apply to existing roads. The main objective of in service safety reviews is to identify the technical, geometric and functional characteristics that may increase the number and/or the severity of accidents.

Safety reviews may be part of a national comprehensive road safety strategy since they represent a low cost method for the periodic evaluation of network safety performance, and the programming of safety improvements. In countries where accident data are not collected and "blackspot" remedial programs are not in use, safety reviews are a suitable methodology for starting systematic safety improvements programs, whereas in countries with more evolved safety management the review can be used to support blackspot analysis.

In the paper, a formal methodology for both carrying out safety reviews and integrating safety reviews into a national comprehensive road safety strategy is described. The methodology has been tested during road safety audits in Italy and has been systematically applied in the safety review of rural road networks.

Keywords: existing roads, safety review, safety audit, risk assessment.

1. INTRODUCTION

A road safety audit is a formal safety examination of a proposed change to an existing road, or a new highway scheme which is carried out throughout the design and construction period. In the audit, an independent, qualified team reports on the project's accident potential and makes recommendations for improvement. When the audit process is applied to an existing road it is called a 'road safety review'.

The objectives of road safety audit are to minimize the frequency and severity of preventable collisions by identifying potential safety risks for road users and ensuring that collision mitigation measures aimed to eliminate or reduce the identified safety problems are fully considered. Road safety audit works in two ways to ensure that safety is improved, namely by removing preventable crash producing elements at the design stage and by mitigating the effects of any remaining risks by the inclusion of suitable crash-reducing elements.

Road safety audit is a formal and independent process addressing the safety of all road users.

It is formal because an audit must follow certain procedures, and these procedures result in formal documents.

It is independent because individuals who are detached from the project design team and road management undertake the audit.

It is conducted to assess the safety of all road users, including pedestrians, cyclists, motorcycles, trucks, buses, and automobiles.

Road safety audits were first adopted in the United Kingdom in the early 1980's. The concept of safety audit spread to Australia and New Zealand in the early 1990's. Through the 1990's, audits were introduced, in different forms, to other countries such as Denmark, South Africa, Canada and the United States. To date,

safety audits are also quickly spreading to other nations both in Europe and in South East Asia.

Road safety audits were first developed for checking the safety performance of new road designs and improvement schemes, and some of the principles have now been extended to apply to existing roads. The existing road network has been developed over many years and suffers basic problems: it was designed when the safety culture was not as widely accepted as it is today; traffic volume, composition and vehicle performance has evolved substantially over the years; and maintenance policy does not always take into account safety concerns.

The main objective of in service safety reviews is to identify the technical, geometric and functional characteristics that may increase the number and/or the severity of accidents. The review can also recommend low cost measures for safety improvements which are often characterized by great cost-effectiveness. Preferably the audit team should suggest potential countermeasures that the owner can implement either immediately or in short time. In some instances, the identified safety issues can be cross-referenced to the collision records to identify the scope for remedial action.

The road safety audit process can be applied to the existing road network either in a route specific manner (which yields detailed safety issues) or in a network wide manner (which yields more general safety issues).

Safety reviews may be part of a national comprehensive road safety strategy since they represent a low cost method for the periodic evaluation of network safety performance, and the programming of safety improvements. In countries where accident data are not collected and "blackspot" remedial programs are not in use, safety reviews are a suitable methodology for starting systematic safety improvements programs, whereas in countries with more evolved safety management the review can be used to support blackspot analysis.

2. IN SERVICE AUDITS INTERNATIONAL CURRENT PRACTICE

2.1. EU

2.1.1. Euro RAP

In 2002 The AA Foundation for Road Safety Research launched its "Euro Road Assessment Program". This is a European wide programme that awards star ratings to roads based on KSI/ billion veh kms. A map describing these routes has been produced, as the starting point for a series of demonstration assessments or reviews. These reviews are check-list based assessments of existing roads, concentrating on Safety Audit techniques rather than historical accident data. Part of the EuroRAP programme is the development of a procedure for "drive through" inspection of routes – the Road Protection Score (RPS).

The RPS describes the protection from accidents that a road provides (elements of primary safety) and the protection from injury when collisions do occur (secondary safety). The results show where safety gains can be obtained and, where this is not cost effective, how some improvement can be made by reducing traffic speed. TMS Consultancy is involved in projects in Norway and Spain.

2.1.2. UK

In the UK the 1988 Road Traffic Act places a statutory duty on local authorities to "carry out studies into accidents on roads", and "to take such measures as are appropriate to prevent such accidents".

Since the early 1970's many local authorities have therefore undertaken work to identify high risk sites, and implement "low-cost" improvement schemes. Much of this work has been monitored, and can therefore be shown to be highly cost-effective.

The UK government has set targets in terms of casualty reduction since the 1980's. In 1987 a target of a one-third reduction in road accident casualties was set for the year 2000. This was met for killed and serious (KSI) casualties but not for slights. In 2000 new targets of a 40% reduction in KSI, a 50% reduction in KSI for children and a 10% reduction in slights expressed as a flow based accident rate were established for 2010.

The general methodology for accident investigation followed by local authorities is as follows:

- identify the accident problem locations;
- rank the locations into priority order;
- analyse the accident and other data at individual locations;
- carry out a site visit;
- define the accident problems;
- examine possible remedial measures;
- estimate the accident savings;
- calculate the economic benefits;
- decide on the best option;
- prioritise the programme of works;
- document the decision in a scheme report;
- implement the remedial measure(s);
- monitor the effectiveness of the measure(s).

2.1.3. Denmark

Since 1997 Denmark applies road safety audit on new road project for systematic prevention of road accidents, according to the procedures described in the Danish Manual of Road Safety Audit [1].

In October 2000 the Danish Road Directorate launched the project "Road Safety Audit of Existing Roads" [2]. Such an audit is to be seen as a supplement, and not as an alternative, to other safety measures on existing roads, e.g. black spots treatment.

The project concerns a road safety audit of a road section in Denmark of about 35 km on the island Lolland. The stretch of road represents different types of roads: motorway, expressway, and highway with small villages along the route.

In the fall of 2000, the road section was systematically inspected for all the matters that might be of importance to the traffic safety. After the inspection, an audit report listing all commentaries and offering recommendations for possible solutions has been prepared. The comments have been given priority according to the seriousness of the relevant traffic safety problems at three levels.

2.1.4. Italy

In Italy, guidelines on road safety audits have been edited in 2001 [3]. The guidelines are based on pilot road safety audits and a research job carried out by the Universities of Naples, Palermo and Florence.

The pilot road safety audits have been carried out in September 2000 by road safety specialists of the Universities of Naples, Palermo and Florence with the partnership of TMS Consultancy. On existing roads, three pilot safety reviews have been carried out comprising a stretch of motorway, a stretch of rural two-lane single carriageway highway and a small portion of an urban network.

Italian guidelines are divided in two sections: road safety audits of highway schemes and safety reviews of existing roads, that is, special emphasis on safety review is given.

To date, some administrations have carried out safety reviews of part of their network. In the years 2000 and 2001 Regione Campania has funded local authorities for safety measures, and as part of these programs existing roads safety reviews, in both rural and urban area, have been carried out.

2.2. Australasia

2.2.1. New Zealand

In New Zealand, safety reviews, which are defined safety audits of existing roads, are part of the national road safety strategy. Safety audit of existing roads started in 1995, essentially as a tool to determine whether a road controlling authority is doing a good job in respect of road safety. Draft procedures were produced in 1996 and revised in 1998 [4].

The audits aim to discover the general themes and trends. They do not aim to audit every road, nor do they aim to identify every deficiency on every road audited. The audits are more like global overviews than detailed inspections.

Approximately 6 audits of existing roads are conducted each year. A central record of existing road safety audits (approximately 35) are retained on a central database. The database has a number of uses [5]:

- it enables authorities' performances to be monitored over time – hopefully they will improve;
- it can record the implementation of the audit teams' recommendations;
- it can be interrogated for common recurring themes. Transfund has started a series of articles that describe these recurring themes and offer advice on how they may be addressed.

2.2.2. Australia

In 1994, Austroads released a broad set of guidelines for a national road safety audit program [6], which has been revised in 2001 [7].

The guidelines specifically address the safety review of the existing roads. The aim is to ensure that the safety features of a road are comparable with the functional classification of the road, and to identify any feature which may develop over time into safety concern [8]. Regular audits of existing roads allow road safety hazards to be identified before they result in accidents.

Two levels of inspection are defined: the preliminary level and the detailed level. The first level involves a broad assessment of the route, highlighting what major problems exist and where they are located. The second level follows, with an inspection of the selected problem locations in more detail, highlighting specific issues and making specific recommendations.

Austroads states that ideally a program of safety reviews that covers every road in the network should be developed. Individual states are incorporating road safety audits at different rates throughout Australia. In New South Wales twenty percent of existing roadways within all regions are to be audited to identify deficiencies in existing roads and identify priorities for action.

In Australia, a formal auditor accreditation exists. An auditor has to meet the following criteria:

- have a minimum of five years experience in road design, traffic engineering; or closely related road safety discipline;
- have successfully competed a training course approved and recognised by the State Road Authority;
- certify that he has maintained current knowledge and experience in road safety auditing.

To be a designated audit team leader or a senior auditor, an individual has to also satisfy the following criterion:

- have participated in at least five road safety audits under the guidance of a senior road safety auditor.

2.3. North America

2.3.1. Canada

In Canada, road safety audits have been introduced in different form across the country. In 1998, the Insurance Corporation of British Columbia released a Draft Discussion Document to raise awareness and stimulate a discussion on audits [9]. In 1999, the University of New Brunswick issued the Road Safety Audit Guidelines document [10], drawing on the audit experiences in New Brunswick. In 2001, the Canadian Road Safety Audit Guide [11] has been released.

Existing roads safety reviews are intended as a mean to address potential collision risks before collisions start occurring. To date, both in urban and rural area, numerous reviews of existing facilities have been undertaken.

2.3.2. USA

In 1996, the Federal Highway Administration (FHWA) dispatched a scanning team to evaluate the road safety audit process in Australia and New Zealand [12], [13]. The program participants recommended that a United States pilot study be conducted. Subsequently, the FHWA started a Road Safety Audit Pilot Project in 1998. The project began by auditing road projects. Safety reviews of existing roads are under discussion.

3. SAFETY REVIEW PROCEDURE

Road Safety Review is aimed at identifying and solving risk factors, by trying to investigate how the road environment is perceived, and ultimately utilised by different road users. Part of the analysis involves a

comparison process between the opinions expressed by a team of safety specialists.

Basing on experience gained in safety reviews of 300 km of urban and rural highways, single carriageway and dual carriageway, the main principles of a formal procedure for safety reviews of existing roads are presented.

The process involves (see fig. 1):

- selection of roads to be reviewed;
- selection of the audit team;
- preliminary data analysis;
- site inspection;
- brainstorming in the office;
- risk assessment;
- writing review report;
- writing response report;
- implementing accident countermeasures;
- writing monitoring reports;
- new review after 5 years.

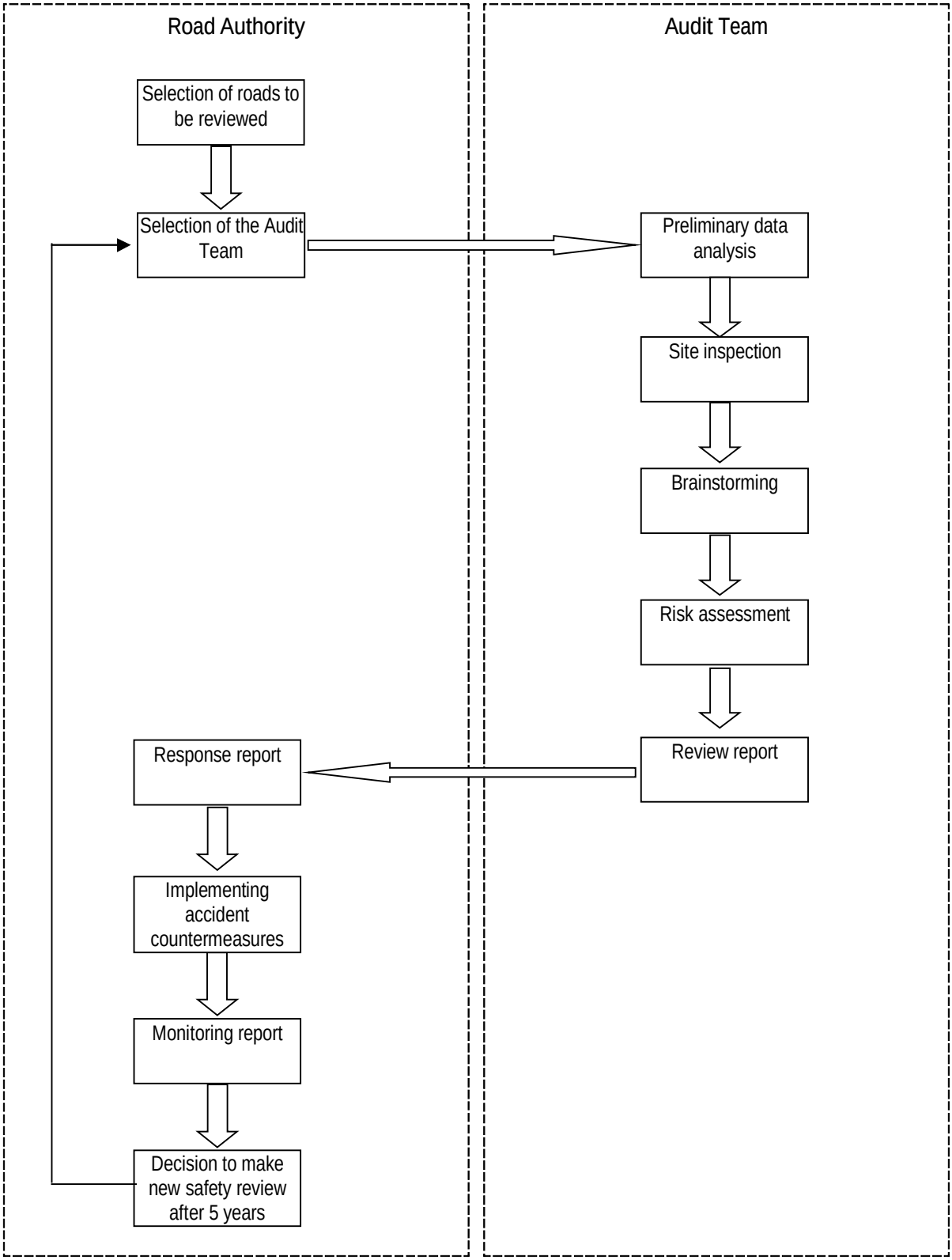

Fig. 1 Safety reviews steps and responsibilities

3.1. Selection of roads to be reviewed

Ideally, all the road network should be reviewed at regular intervals. Since budget and time constraints, a Road Authority should periodically make a program of safety reviews based on a priority scale aimed at maximum accident cost reduction.

Unlike in accident black spot treatment programs, the methodology for the selection of road to be reviewed is not crucial. In any stretch of road the reviews identify general and detailed safety problems; basing on results of the reviews the countermeasures may be selected according to the cost effectiveness of remedial treatments. Selection of roads may be based on different methods depending on the aim of the reviews.

In the first phase of the program, it might be appropriate to select roads of different types, in different environment and in different geographical area. By this way, a broad overview of the main safety problems of the network is given. The Audit Team could make a general inspection of the network and select sites to be reviewed.

Analytical methods based on maximum potential for safety improvement may be applied. Accident data, traffic data and safety prediction functions are needed. Potential for safety improvement is the difference between the number of accidents at the sites and the number of expected accidents at similar sites with the same traffic [14]. A refinement of the method consists in assessing the difference between accidents at the site under examination and expected accidents at sites with base conditions and the same traffic [15].

The number of accidents expected to occur on a stretch of road during a specified period of time can be estimate by the Empirical Bayes technique, which corrects for regression-to-mean bias [16]. The estimate of the expected accidents depends on the accident count of the site and the estimate of the expected number of accidents based on the accident history of similar sites, by the formula:

$$\mathbf{m = w \times P + (1-w) \times x} \qquad \mathbf{(1)}$$

where:

- m = estimated of expected number of accidents;
- P = number of accidents expected on similar sites, predicted by safety prediction functions incorporating available variables that may contribute to unsafety;
- x = accident count of the site;
- w = weight given to the accidents expected in similar sites. This weight depends on the accident record (the more the accidents, the lesser the weight) and reliability of the prediction functions (the more the reliability, the more the weight).

Potential for safety improvement may be estimated by one of the two formulas:

$$\mathbf{PSI = m - P_t} \qquad \mathbf{(2)}$$

$$\mathbf{PSI = m - P_b} \qquad \mathbf{(3)}$$

where:

- PSI = potential for safety improvement;
- m = estimated of expected number of accidents;
- P_t = number of accidents expected on similar sites, predicted by safety prediction functions based on a model that includes traffic volume but not treatable variables;
- P_b = number of accidents expected on similar sites, predicted by safety prediction functions based on a model that includes traffic volume and predominant values of the treatable variables.

3.2. Selection of the Audit Team

The Audit Team (the team which carries out safety reviews is called with the same name of the team which makes safety audits since has the same qualification) should have two main requisites: independence and qualification.

Independence from the design, maintenance and operation of the road to be reviewed is needed since the Team has to look only at safety problems applying "fresh eyes" to the task.

Qualification is vital for the process to be effective, since addressing the safety problems and providing recommendations to eliminate or mitigate them doesn't give any real benefit in terms of accident reduction if the task is not based on sound road safety engineering experience and practice.

Auditor Team qualification implies [16]:

- the ability to understand how real accidents happen, and to understand what type of accident can take place in relation to the characteristics of the traffic and of the road;
- the ability to understand if a standard non-compliance or a road deficiency gives rise to consequences in terms of increasing the number and/or the severity of road accidents;
- the ability to analyse the needs of all the types of road users, or rather to see the existing roads from the point of view of pedestrians, children, cyclists, drivers of commercial vehicles, disabled persons, etc., and not only of the car driver;
- the ability to suggest recommendations that are effective and practicable solutions to individual problems, that is, solutions that have already shown their effectiveness in the accidents reduction in circumstances similar to those to be reviewed.

To effectively make the aforementioned tasks, Audit Team should not be a "one man Audit Team" [13-15], since diverse backgrounds and different approaches of different people are beneficial. The cross-fertilization of ideas that can result from discussions is helpful. Experience has shown that more people carrying out safety audits will identify more safety issues than a single safety auditor.

The basic skills required for assuring the Audit Team Qualification (one person may have more skills) are the followings [11]:

- a Road Safety Specialist**.** This person should have recognized expertise in the understanding of what causes collisions, and what solutions can be effective in reducing the collision risk.

This person typically has experience in conducting collision-prone location safety studies or collision investigations;

- a Traffic Management Engineer. This is a person who has experience in the principles of traffic flow, the relationship between capacity and demand, the causes of congestion, the proper placement of signs and pavement markings, traffic signal operations and methods of improving traffic efficiency;
- a Geometric Design Engineer. This is a person who has extensive road design experience, and should have up-to-date knowledge of the latest trends in design.

3.3. Preliminary data analysis

Safety reviews can be carried out without examination of any preliminary data. However, preliminary analysis of traffic data, accident data and geometric details, if available, may increase the accuracy of the review.

Accident analysis, which can be carried out by the traditional safety engineering methodologies, may underline safety deficiencies and accident patterns. It is helpful for the audit team which will focus with more details on the features which may be contributing factors of the identified accident problems. However, it is important to point out that accident data do not have to be used as the only clue. Any aspect which may be a potential accident contributing factor has to be addressed, independently of the circumstance that reported accidents directly linked to that factors are present.

3.4. Site Inspection

Site inspections have to be performed both in daytime and night time. In different light conditions, indeed, road is perceived in another way and many safety problems not identified in daylight conditions may be clear in night time.

During site inspections, the Audit Team should run the road in both direction at normal speed. In a second drive through at low speed, specific inspections of sites which showed the main safety concerns have to be performed. Specific inspections require the site to be analysed by driving at low speed, walking and looking in detail at the safety concerns. Junctions which pose the greatest safety problems may be reviewed separately, since the time constraints and complexity of the review.

Videos of the road and photos of the safety problems may be useful both for further in office investigation and for supplementing the review report.

Site inspections should not be limited to the road itself. They should extend to the adjacent network with the aim of identification of the context of the road in the network and to see interaction of the road with the rest of the network. Moreover, the analysis has to look not only the road, but also the environment which can interact with the road and the road users.

3.5. Brainstorming

In the office, the Audit Team focuses on results of inspections and on safety problems. Analysis of photos and videos done in site inspections are helpful in the brainstorming task.

First, potential accident scenarios have to be identified. Accident scenarios are groups of accident which show similarity in the link of events and casual relationships in the different phases which lead to the collisions.

Secondly, all the auditors, independently each other, write a list of safety problems taking into account potential accident scenarios. Each safety problem is discussed by the team in order to assess if it is really a potential contributory factor of road accidents and if countermeasures for his elimination or mitigation can be carried out.

Safety issues are divided in general and specific problems. General problems are frequently present along the route, specific problems are present in one or few sites (e.g., a junction or a bend).

For any problem, the Audit Team define recommendations, which are engineering solutions to the reported problem. Recommendations produced by the Audit Team should indicate the type of measures, without specifying detailed technical issues. Recommendations should be as practical as possible, in order to be effectively addressed by the Road Authority.

Further, recommendations should be based on reliable control data, that is, information on costs and benefits of the solutions that have already shown their effectiveness in the accidents reduction in circumstances similar to those under review. Traditional road safety engineering work involves identifying high risk locations from accident data, carrying out detailed accident studies at those locations, implementing relevant remedial measures, and then monitoring the effects of those treatments. The results of these monitoring activities provide useful control data for auditors. The main sources of data are publications [18]-[20] and databases. For example, a database is managed by TMS [21], that has collected three years before and after data on over 850 safety improvements carried out by local road authorities throughout Great Britain.

Audit Teams can use checklists, which are a prompt aimed at ensuring that important safety problems are not overlooked. However, it is important to state that checklists are a prompt and not a substitute for knowledge and experience, that is, checklists should aid using safety engineering experience and judgement and should not be used as “tick” sheets [22].

Checklists, although in different forms, are included in all the international Road Safety Audit guidelines and reflect what safety engineers believe are the most common safety problems.

3.6. Risk assessment

When considering audits suggestions, capital expenditure may be required to address the safety issues identified to reduce the collision risk, and the owner would need to prioritise the audit suggestions. Risk assessment assists in determining the priority of safety issues identified by the safety reviews. Various risk assessment procedures may be used.

The easiest approach involves the Audit Team prioritising the safety issues basing on experience. However, this method is somewhat subjective.

A more objective approach involves the prediction of the frequency and severity of potential accidents associated with each problem identified in the audit report. A risk assessment matrix, where the risk score

depends both on the frequency and severity of potential accidents, may be used (see table 1). The auditors would go through the report and give each problem a risk score, making their assessment of risk if nothing is done. The auditors would then go back through their recommendations, and, making the assumption that the recommendation will be carried out, the auditors re-assess the risk. With this procedure, the Audit Team not only looks at the existing road deficiencies, but also takes into account that those problems could produce road accidents and that the suggested improvements may reduce the accident consequences.

Risk assessment allows to evaluate:

- if the existing scenario is really a risky one;
- which road users are most at risk;
- the risk improvement if recommendations are carried out;
- a comparison of risk improvement between the different recommendations;
- road users which have more benefits;
- type of accidents affected by the recommendations.

Table 1 Risk assessment matrix

Severity of outcome	Probability of outcome			
	>1/year (score 4)	1 every 1-3 years (score 3)	1 every 3-7 years (score 2)	<1/7years (score 1)
Multiple fatal (score 4)	16	12	8	4
Fatal/serious (score 3)	12	9	6	3
Minor injury (score 2)	8	6	4	2
Damage only (score 1)	4	3	2	1

3.7. Review report

The Audit Team writes the Safety Review Report in "problem/recommendation" format, where the problem is described in terms of an accident risk to a road user, and the recommendation is an engineering solution to the reported problem.

During the review, there may arise safety issues for which there are no specific short term remedies. In this case, the safety issues should not be ignored but identified for further investigation.

The report should contain, as a minimum, the following sections:

- road name and location;
- dates of inspections and other phases of the review;
- Audit Team members and qualifications;
- Client name and address;
- information on meetings (including with whom, date and reason for meeting);
- information on data provided by the client;
- description of the procedure used to conduct the review;
- statement regarding the disclaimer for liability of the Audit Team;
- detailed description of the safety problems, and the potential accidents caused by the problems; if possible, photos exemplifying the problems should be provided;
- description of recommendations aimed at eliminating or alleviating the safety problems;
- synthesis, in tabular format, of problems and recommendations;
- concluding statement;
- names and signatures of auditors.

3.9. Client actions

The active participation of the Road Authority to the review process is essential. If safety reviews are not followed by corrective actions, the process is ineffective. Below, a systematic process of follow up actions is shortly described.

3.9.1. Response report

The response report outlines the actions that will be taken in response to each safety concern identified in the review report.

The following types of responses are possible:

- the client does not accept that the problem exists. In this case the response report should produce some evidence as to why the problem is not valid;
- the client accepts an identified problem, but does not accept the recommendation. In this case three different scenarios are possible:
  - the recommendations will not be addressed since constraints. These constraints need to be explicitly described;
  - the recommendation will be addressed in the future, since budget constraints (or other reasons that need to be documented);
  - an alternative measure will be implemented;
- the client accepts the recommendation and will change the road by adopting the Audit Team suggestions.

It is important that a copy of the response report is returned to the Audit Team.

The report might be prepared according to the format presented in table 2.

Table 2 Response report format

Audit report paragraph no.	Safety problem accepted	Recommendation accepted	Action to be undertaken or reason to not implement measures
	Yes/Not	Yes/Not	

3.9.3. Monitoring report

An essential follow-up to the safety review is monitoring the safety performances of the road and the actions undertaken in response to the safety review.

Three monitoring reports should be written respectively one year, three years and five years after the completion of the review. The monitoring report should contain:

- description of measures implemented (works carried out, data of the works, costs, projects);

- description of the main maintenance operations;
- program of measures planned but not implemented;
- traffic and accident data.

After five years a new safety review should be carried out in order to look at the modifications in the road, in the environment and in the traffic. Furthermore, the state of the art on road safety quickly evolves and new reviews take into account both the enhancement in the safety culture and the advance in the road practice.

4. IMPLEMENTING ROAD SAFETY REVIEWS

Safety reviews may be part of a national comprehensive road safety strategy (see fig. 2). To this aim, the National Road Safety Plan should underline the need for safety reviews and recommend state and local road authorities to adopt the reviews as a standard practice for the periodic safety evaluation of the road network safety.

The process needs national guidelines which define operative procedures to carry the reviews by each road authority. Guidelines already in use in other countries may be a good starting point for the process start up. However, local practices and specific features have to be taken into account and national guidelines should strongly reflect these factors to be effective.

Before developing a formal road safety review, a pilot road safety review program should be carried out. The pilot program would enable the road authorities to fine-tune the process to fit into other local processes and practices.

A pilot road safety review program should include preliminary training of some groups of safety auditors which will participate to the reviews. Safety managers of road authorities should also be trained to be familiar with the general safety review process and techniques. The pilot reviews should include all the types of road which could be reviewed in the future, both in rural and in urban area. Selected state and local road authorities

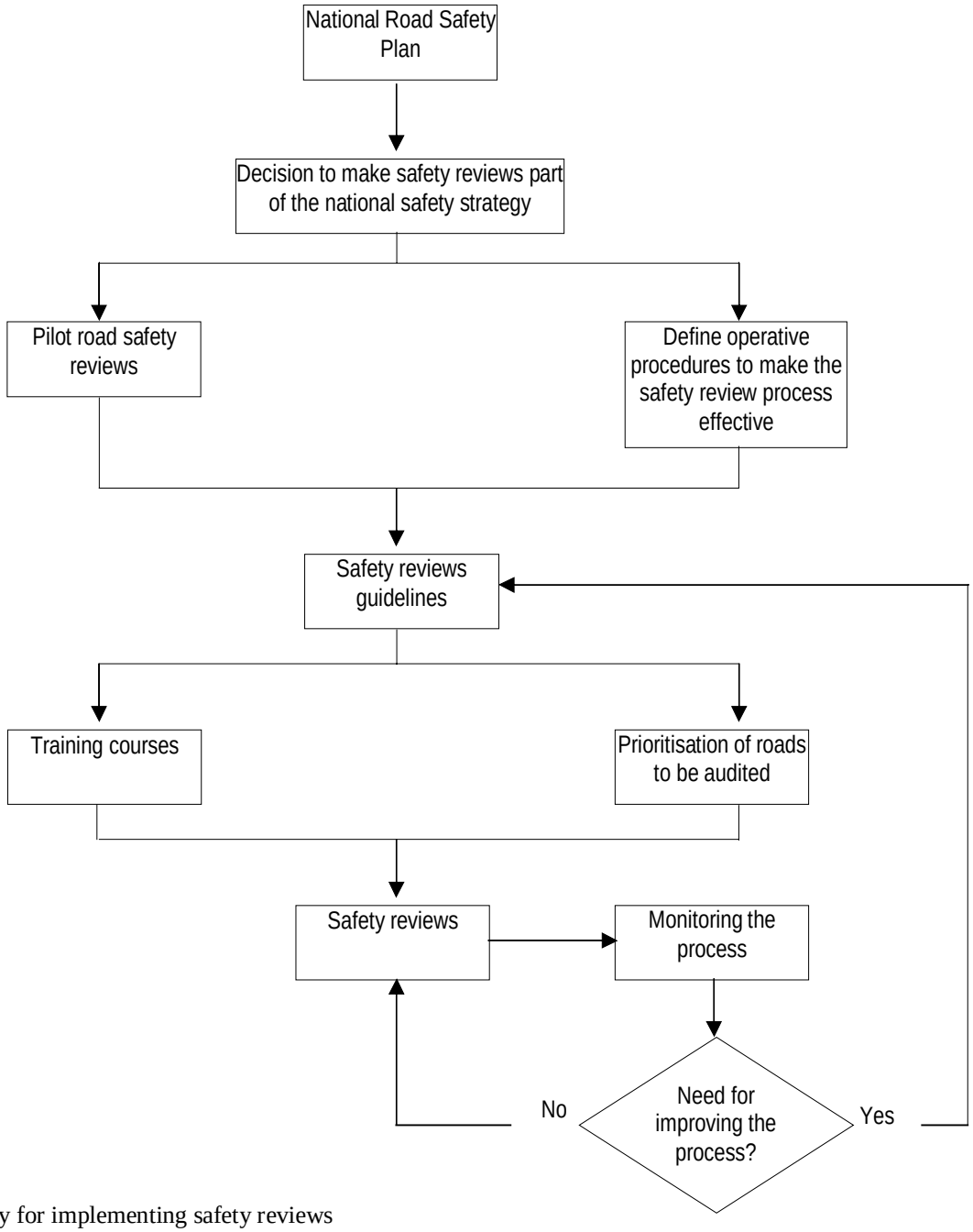

Fig. 2 Strategy for implementing safety reviews

should take part to the program in order to evaluate the real capability to manage the review process and implement the recommendations.

Once guidelines have been edited, to make the review process operative two tasks have to be performed: selection and prioritisation of the roads to be reviewed, and training of safety auditors and of road authorities safety managers.

Training of Road Safety Auditors is essential and any audit team member should have attended recognised road safety engineering training and Road Safety Reviews training courses.

The followings are some of the main topics that a road safety reviews training course should comprise [23]:

- what is, and what is not, a Road Safety Review;
- why Road Safety Reviews are undertaken;
- road environment safety (what is a safe road);
- roadside hazard management;
- road alignment and delineation;
- signs and pavement markings;
- rural roads and intersections;
- risk assessment;
- different road users and their needs;
- how to use checklists;
- what is a road crash (crash investigations and
- analysis);
- a review of a stretch of road;
- writing a Road Safety Review Report;
- writing a Road Safety Review Response Report.

The safety review process needs to be monitored, identifying the common safety concerns arising from the reviews, and the level of compliance with the process.

The monitoring includes evaluation of the safety gains and of the cost of both the reviews and the measures implemented in response to the recommendations of the audit teams. As a result of monitoring, the need for amendments to the procedure and revision to the guidelines might emerge.

5. CONCLUSIONS

Safety reviews are an extremely valuable tool for improving safety of existing road network and may be part of a more comprehensive road safety strategy.

Safety reviews represent a low cost process for the periodic evaluation of network safety performance, and the programming of safety improvements. They are becoming an accepted practice in many agencies around the world. In countries where accident data are not collected and "black spot" remedial programs are not in use, they are a suitable methodology for starting systematic safety improvements programs, whereas in countries with more evolved safety management the reviews can be used to support black spot analysis.

Qualification of the safety auditors is vital for the process to be effective, since addressing the safety problems and providing recommendations to eliminate or mitigate them doesn't give any real benefit in terms of accident reduction if the task is not based on sound road safety engineering experience and practice.

Moreover, the process needs the active participation of the Road Authority, since if safety reviews are not followed by corrective actions safety benefits cannot be reached.

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